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SID 62-300-14

APOLLO MONTHLY PROGRESS REPORT
(U)

NAS9-150

1 July 1963

4.5.4.1

CLASSIFICATION CHANGE
To UNCLASSIFIED
By authority of [illegible]
Changed by [illegible] Date [illegible]
Classified Document Master Control Station, NASA
Scientific and Technical Information Facility

Report Period:

16 May to 15 June 1963

[redacted]

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NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

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PROGRAM MANAGEMENT

STATUS SUMMARY

The definitive Apollo contract, NAS9-150, was signed by NASA-MSC and S&ID during the report period. The contract is now in Washington for ratification.

The modified launch escape motor for boilerplate 6, the pitch control motor, and the pitch control spare were shipped to WSMR and accepted on 23 May.

The second and third drop tests of boilerplate 3 were successfully conducted at the El Centro Naval Air Facility during the report period. The fourth test in this series of ringsail parachute drop tests is scheduled to take place during the next report period.

All GSE has been completed for boilerplates 2,3,9, and 19. The seven remaining GSE units for boilerplate 6 and the two remaining units for boilerplate 1 are scheduled for completion during the next report period.

CONTRACTS

Preliminary Contract Change Proposals (PCCP's)

Twelve PCCP's, supporting contract change authorizations (CCA's), were submitted to NASA during the report period. CCA's covered the following:

CCA 35 Spacecraft/Saturn I Launch Vehicle Interface

CCA 38 Furnishing of Headsets for Shirtsleeve Operation

CCA 39 Extension for Thrust Chamber

CCA 40 Furnishing of Guard Service at WSMR

CCA 41 Procurement of One Flight Director Attitude Indicator

CCA 42 Pyrotechnic Initiator in Launch Escape Subsystem

CCA 43 Addition of CO_2 Sensors to Environmental Control Subsystem

[redacted]

[redacted]

CCA 44 Redesign of Pulse Code Modulation Telemetry System

CCA 45 Reproduction Equipment for WSMR

CCA 46 Contractor Furnished Equipment for WSMR

CCA 47 Procurement of Two Additional Q-Ball Angle of Attack Transducers

CCA 50 Furnishing of Two Technicians to Langley Research Center

SUBCONTRACT STATUS

The negotiation bases for thirteen of the major subcontractors have been presented to NASA for review. Negotiations have been completed with nine contractors — six contracts have been written, and the remaining three are in process. Negotiations are currently in process with four additional contractors. The target dates for the completion of these negotiations are as follows:

Subcontractors	Target Dates
Aerojet	June 1963
Marquardt	June 1963
Minneapolis-Honeywell	June 1963
Northrop-Ventura	June 1963

NEW PROCUREMENTS

During the report period, the Radcon-Emertron Company was selected as the contractor for the beacon antenna, and the RCA Princeton Laboratories were selected as the contractor for the TV camera.

Orders are in process for the following items and are scheduled for placement as indicated:

Items	Target Dates
2 kmc antenna	June 1963
In-flight test system	June 1963
Pyrotechnic batteries	June 1963
Up-data link digital computer	July 1963

[redacted]

DEVELOPMENT

TECHNOLOGY

Flight Performance and Control

Simulation of transposition and docking with and without a service module reaction control subsystem (RCS) failure indicates that docking with a failure of one of the four motor clusters will result in an average increase in RCS propellant consumption of 50 pounds. The increase in propellant consumption is greatest when the motor cluster located above the astronaut's head fails and the command - service module translates away from the target while performing the 180 degree rotational maneuver.

With only three quads operating, the diameter of the docking drogue would have to be increased from 2.0 feet to 2.4 feet to accomplish the docking with the same probability of success as that achieved when four quads are operating.

Studies have been completed to determine the jettison time of the launch escape subsystem (LES) tower and the guidance activation time of the second stage booster for Saturn V missions. Results showed that the LES tower should be jettisoned 34 seconds after S-IC/S-II physical separation (184.5 seconds after launch) and that the S-II guidance should be activated either five seconds after or at a sufficient time before LES jettison, to ensure spacecraft pitching rates of less than 0.3 degrees per second.

Requirements for command module - service module separation prior to atmospheric entry have been defined, based on a probability study of avoiding in-flight collision. It was found that a 5-minute separation time prior to entry and a 10-feet per second increment of velocity are sufficient to provide satisfactory separation. With these parameters, 22 pounds of service module RCS propellant and a two-step sequencer would be required. The initial separation thrust attitude with this open-loop system requires that the service module RCS -X jets be oriented approximately 65 degrees in regard to the local horizontal. The separation sequence is to fire the service module RCS -X jets and release the command module/service module separation system. Two seconds later the service module roll jets are fired for 5.5-seconds. The -X jets continue to burn until their propellant is exhausted.

MIT will furnish the following navigation and guidance hardware to be used in simulator I:

1. A breadboard rack-mounted Apollo guidance computer with production model wired-core memory modules

2. Three class A production model coupling display units

3. One complete set of production model navigation and guidance controls and displays

4. Associated support electronics including portions of the power and servo assembly, guidance computer support equipment, and spares.

A committee representing MIT, NASA, Grumman, and S&ID will outline the required support electronics. This committee will also establish requirements for an erasable memory unit to be used with the breadboard guidance computer. All of the required equipment is to be delivered to S&ID by 1 April 1964.

MIT will furnish all required programs, equations, steering laws, and other computer information to implement simulation studies being conducted by S&ID. MIT has furnished all available data for the assembler language, the interpreter program, the sequence control program, the documentation of the computer interface circuitry, and detailed computer instruction execution.

<u>Thermal and Fluid Dynamics</u>

Thermal analysis shows that heating is required for the service module RCS engines. Heaters on the propellant lines near or on the injector valves will prevent freezing without additional insulation, assuming propellant enters the RCS quad with a temperature of at least 40 F. Alternate heating methods for possible reduction of electrical power requirements are being considered.

Tests have been completed to verify the design of the insulator shield required to protect the service module structure from overheating due to RCS plume impingement. Preliminary data analysis shows that plume pressures and heat transfer are in agreement with theoretical predictions. Therefore, the shield design is considered satisfactory.

Analysis of startup transients in the service propulsion subsystem (SPS) shows that 100 percent of main-stage chamber pressure can be attained within the specified 600 milliseconds, assuming a nominal propellant tank pressure of 175 psia and current propellent valve characteristics.

Analysis of shutdown transients shows that appreciable surge oscillations can occur in the sump tank if sump ullage is small (less than 0.5 cubic feet). Design changes to minimize these surges are being developed.

An analysis of a channel heat sink for the command module cavity pressure air vent has been completed. The recommended design is a system of parallel layers of copper that will lower entry plasma temperatures sufficiently for entry with an open vent.

Analysis of temperature gradients and temperature histories of a heat shield specimen being radiantly cooled from an initial 70 F to space temperatures shows respective temperatures of -282 F and -265 F for 1-inch and 2-inch thick specimens after 100 hours, assuming an emissivity of 0.9.

Angles of attack and sideslip calibrations were completed for the Q-ball (attitude sensor). Data were obtained for attack and sideslip angles of -12.5 to 40 degrees and -20 to 7.5 degrees, respectively, in a Mach number range of 0.1 to 0.26. Preliminary examination indicates the data are consistent within ± 1 degree throughout the calibration range and that the Q-ball will perform satisfactorily.

The free oscillation and dynamic stability models of the command module and launch escape vehicle and related wind tunnel test equipment have been modified and were delivered to Ames Laboratories for transonic tests.

Computations of electron densities surrounding the command module have been continued to define the effects of communications blackout. Preliminary estimates indicate blackout concentrations of more than 10^{12} electrons per cubic centimeter below 400,000 feet at 36,000 feet per second.

Further reliability studies of the welded tubing joints and coldplates of the environmental control subsystem (ECS) coolant loop are being conducted. It may be necessary to provide redundant coolant systems or develop alternate passive coolant methods for emergency operation of the spacecraft electronics without the ECS coolant loop.

An explanation and description of the pressure suit circuit computer program were completed and transmitted to Grumman for possible use in predicting the performance of the lunar excursion module suit.

Life Systems

Preliminary transposition and docking simulator studies and tests are continuing. Human factors are being considered in the simulated manuevers of transposing the lunar excursion module from the service to the command module. Nominal and emergency docking are both being simulated, with emphasis on the latter.

A preliminary list of possible Apollo mission diseases, their symptoms, and methods of treatment are being compiled for incorporation into medical data sheets. These data sheets are to be placed in the command module for use by the crew if a communications failure prevents the crew receiving medical advice from earth stations. The data sheets will list symptoms, causes, and emergency treatment for each disease.

Simulation and Trainers

The following five system trainers have been recommended, based on a request by NASA for a system trainer plan:

1. Stabilization and control
2. Communications
3. Electrical power
4. Environmental control
5. In-flight test

An early approval to proceed will be required to meet engineering schedules.

A simulation program plan encompassing the requirements of all affected groups has been developed. The plan uses three evaluators and two simulators for the evaluation and verification of Apollo systems during the various missions. A technical study of the plan is in progress. Formal documentation of the plan should be completed during the next report period.

Structural Dynamics

Full-scale boilerplate and 1/10-scale model water drop tests have been made to investigate high horizontal-impact velocities and extreme pitch angles. Previous test results and analyses had indicated that the command module would come to rest in the second stable position (partially inverted) for horizontal velocities greater than 12 to 15 feet per second, at zero roll and high pitch orientation. Under certain conditions (30 feet per second horizontal velocity, -30 degree pitch, for example) the command module exhibited a different behavior and was observed to strike the water and plunge almost vertically, followed by "pop-up" to the surface in an upright position. It appears that for a narrow range of flight path angles the hydrodynamic forces are so aligned with the center of gravity that little or no moment is applied to the vehicle. At slightly higher horizontal velocities, the command module pitches into the second stable attitude.

Lateral bending modes were calculated for the Saturn IB space vehicle with Apollo boilerplate and spacecraft payloads. The boilerplate showed a first mode frequency of 1.45 cycles per second compared to the spacecraft's frequency of 1.26 cycles per second. The greater stiffness of the boilerplate vehicle accounts for the difference. A similar condition had previously been found for the Saturn I, where the first mode had a frequency of 1.55 cycles per second for the boilerplate and 1.43 cycles per second for the spacecraft.

The vibration and acoustic test plan for spacecraft 006 is being completed, and revisions to existing Apollo test requirements have been outlined. Test fixture design requirements have been established, and the design has been initiated by the engineering development laboratory.

Acoustic evaluations were made of the command module oxygen purging operation and of the communications headset. Tests conducted during the purging operations indicated that no adverse acoustic effects are likely and that only a momentary uncomfortable period will be experienced during purging. Analysis of the communication headset equipment resulted in the establishment of a requirement for 70-percent intelligibility, in a cabin noise environment of 131 decibels (88.5 decibels inside the pressure suit helmet)

SPACECRAFT AND TEST VEHICLES

Structures

All Saturn I adapter structure drawings were completed on schedule.

The second and third drop tests of boilerplate 3 were conducted successfully during the report period. These tests evaluated the performance of the parachute system with the command module in an apex-forward attitude.

Preliminary data analysis from the solid parachute development program indicates substantially lower opening loads than that for ringsail parachutes.

Seven design layouts for the lunar excursion module adapter and accompanying support methods were completed and delivered to Grumman to aid a Grumman-NASA presentation. These studies were supplemented by comparative weight data analyses of the four docking concepts. Dynamic loads for the command and service modules in the docked position have been issued.

Material for the command module heat shield substructure was changed from PH15-7Mo steel to PH14-8Mo steel, to improve low temperature characteristics.

Effort has been started to relocate the equipment in the command module to accommodate the fixed crew couch, to improve the center of gravity location, and to improve crew operations. The tasks include revisions to the right-hand, left-hand, upper, lower, and aft equipment bays, the forward and aft equipment compartments, the main display panel, and the side consoles.

A program directed toward obtaining the effects of a 100-percent, 5-psi oxygen environment on approximately 150 nonmetallic materials has been initiated. Preliminary results on Polyvinylchloride wire insulations indicated non-inflammability at 500 F.

Five water drop tests of boilerplate 2 were conducted during this report period. During the fifth drop, fracture of the aft heat shield occurred during simulation of the condition created by a critical pitch deviation plus angular effects due to a 10-degree wave slope.

Guidance and Control

The basic design of the solenoid valve test stand has been completed and construction is scheduled for completion in July. The test stand is to be used to evaluate and verify interfaces between the solenoid valve driver amplifiers, the reaction jet fuel and oxidizer valves, and the service propulsion engine ignition system.

Pertinent design features of the test stand are as follows:

1. The capability of operating the RCS oxidizer valve simultaneously with independent pressure supply systems, so that any valve mismatch can be determined under varying pressures of fuel and oxidizer supplies

2. Throttling valves located upstream and downstream of the test valve to permit simulation of transient as well as steady-state flow condition

3. High-frequency response instrumentation to allow the determination of any parameter variation during transient conditions

4. An environmental test chamber to enclose the test valves for minimum and maximum operating temperature evaluations.

Functional mode diagrams for the navigation and guidance system have been brought up to date with the completion of both the attitude control mode and the course alignment mode. A preliminary report has been released providing the signal identification, source, and functional description for each display and control on the lower equipment bay navigation and guidance panel.

Meetings between S&ID and MIT were held to consider the in-flight test system (IFTS) and provide coordination on the required interface control drawings, navigation and guidance signals hard-wired to the IFTS, use of the IFTS ac-dc meter, and the MIT IFTS philosophy. MIT has agreed to use the 38-pin Hughes connector as the access connector on each power and servo assembly tray. GSE handling fixtures and jigs were studied in detail.

SPS high-altitude abort requirements have been published and forwarded to Minneapolis-Honeywell for incorporation into their analysis program. A detailed review of the design specification was conducted in preparation for a design review meeting held during the early part of June.

Communication

As a result of a meeting with NASA, Grumman, and RCA, the basic procurement specification for the command module TV camera has been revised to make it compatible with the lunar excursion module TV camera. The required changes are an additional oscillator in the camera to provide sync instead of using an output of the central timing equipment, conversion from 115 volts ac, 3-phase, 400 cycles per second operating input voltage to 28 volts dc, alteration of the picture sync format, and reduction of the lines per frame from 400 to 320.

To increase the PCM telemetry capability for flight qualification measurements on early spacecraft flights, S&ID has proposed expanding the present PCM equipment or using NASA-furnished PAM/FM/FM equipment.

[redacted]

An analysis of communication problems between the command and lunar excursion modules during lunar orbital rendezvous indicated that improvements in circuit margins are necessary. An evaluation of methods to achieve this objective was made jointly by S&ID and Collins. A decision to decrease the VHF/AM receiver noise level from 11 decibels to 8 decibels was made.

A digital data link for Apollo manned missions will be provided by the addition of a receiver-decoder package and the modification of associated communication equipment to provide a capability to send ground operation support system (GOSS) information and data to the spacecraft for direct use in such systems as the navigation and guidance computer.

Instrumentation

The selection and specification of suitable instrumentation sensors for spacecraft 009 is in progress. The present effort is directed toward an early establishment of potential sensor supply.

Radiation detection and measurement system requirements have been established, and a firm system has been designed. Procurement specifications are ready for initial release for bid purposes. A purchase order should be placed in October 1963, and equipment delivery should be accomplished by March 1964.

Several design characteristics have been incorporated in the PCM telemetry system to ensure a flexible PCM system that can be adapted to the variable requirements of the Apollo program. These characteristics include a bit rate of 51,200 bits per second; a prime frame consisting of 120 eight-bit words (50 prime frames per second); a weight increase of no more than 8 ounces; no change in telemetry transmitted power; and the provision of the capability for 70 additional channels.

Environmental Control Subsystem (ECS)

The two command module vent valves used to provide the crew with fresh air during the postlanding phase have been eliminated. These two valves were manually operated, one drawing in fresh air and the other exhausting air from the cabin. Opening the main hatch will provide all the fresh air needed by the crew. This change simplifies postlanding ventilation, reduces weight by 7.0 pounds, reduces battery requirements by 25 watts of operating power, and eliminates two penetrations through the cabin bulkhead.

A 900 psi, 3-pound capacity oxygen surge tank has replaced the two entry oxygen tanks (7500 psi, 1-pound capacity each). The surge tank will be connected to the cryogenic storage subsystem (CSS) immediately upstream of the flow regulators and will have continuous emergency and reentry capabilities at any time during the mission. A surge tank shut-off valve and relief valve venting into the command module are the only auxiliary components required. This change eliminates complex high-pressure entry equipment, increases entry oxygen storage capacity, reduces weight approximately 5 pounds, and eliminates the GSE requirement for installing the two prefilled oxygen tanks in the spacecraft. System redundancy is provided by the astronaut backpacks.

The regenerative heat exchanger has been deleted. It was considered to be unnecessary since cabin temperature will fall only slightly below 70 F during transients. The present concept requires one man in a suit at all times and a suit inlet air of 50 F to minimize sweat rate.

The addition of a carbon dioxide sensor to the ECS will provide a means to monitor the carbon dioxide level within the command module. The sensor, which will weigh approximately one pound, will be electrically coupled with a meter displayed on the panel, providing a visual readout to the crew.

Electrical Power Subsystem (EPS)

The exploding bridge wire initiators of the LES motor will be replaced with hot wire initiators. The use of the present standard hot wire initiators will require the use of a booster cartridge in the solid rocket motors. This change will result in a weight reduction of 15 pounds.

Two subcontractors are involved in hot wire initiator development programs. Problems have been encountered in maintaining the required bridge wire tolerances and in avoiding leakage of hot gases past the pins and the ceramic header. Conferences are being held with the suppliers to resolve these two problems.

All pyro-sequencer designs now include isolated redundant logic and pyrotechnic buses having individual control, and parallel timers with series-connected contacts.

Pyro-sequencer breadboard tests for boilerplate 6 are scheduled for completion by 1 July. The tests for boilerplate 12 are to be completed by 15 August, and tests for boilerplate 13 will be completed by 15 September.

During the report period, several fuel cell modules were tested by Pratt & Whitney. The best results were obtained from Module 402-2, which operated 192 hours under load and performed within specification limits most of the time.

Bonding tests have been satisfactorily completed on the launch escape motor ribbon cable.

Electronic Interfaces

Changes are being made in the configuration and location of the command module display panels and their supports to conform with new requirements caused by the fixed-couch concept. The layout of the displays and controls of the new panels reflects the latest operational task analysis and system design. To improve the center of gravity location, consideration is being given to relocating the command module electronic equipment. The electronic spares are being located in the aft bulkhead instead of in the lower equipment bay.

Procurement specifications for the IFTS equipment are being up-dated. The supplier of this equipment will be required to meet specifications for a smaller, higher-density package. A study of mechanization techniques is being made to reduce the present estimated weight of the package from 43 pounds to the 36-pound goal set by NASA. Newly qualified components should reduce power requirements from 45 to 25 watts maximum. This equipment is being incorporated into current specifications.

S&ID has presented a recommendation for the supplier of the IFTS equipment. Early acceptance by NASA is required to avoid possible slippage of flight hardware schedules.

Service Propulsion Subsystem (SPS)

Measurement points for spacecraft 009 have been reviewed by NASA and S&ID. Approximately 65 SPS measurement points are now included in the list. Of these, 29 are telemetered flight measurements and the remainder are checkout measurement points.

At NASA's request, individual SPS tank quantities will be telemetered. The total reading will be deleted.

Heat transfer testing of the one-inch diameter helium heat exchanger has been completed. The results of the tests show that the helium outlet temperature was not within the required ±20 F of the water inlet temperature, but they do indicate that the heat exchanger is a valid concept.

[redacted]

A mock-up of the simulated spacecraft propellant distribution system has been completed for test fixtures F-1, F-2, and F-3. This mock-up change was required because the service module engine had been relocated 10.8 inches aft, due to the engine nozzle heating problem. Calibration of the F-3 test fixture propellant tanks has been completed.

Nineteen firings of the service propulsion engines were accomplished during this report period. Evaluation of modifications to the doublet and quadlet injector patterns is continuing (see Table 1).

Table 1. Apollo Service Propulsion Engine Injector Development Test Program

Serial Number	Pattern Designation and Type	Type Evaluation	Number of Firings	Number of Firings Unstable	Remarks
AF-33	PONX-51-3, Quadlet	Pattern evaluation	7	2	
AF-1	POD-31-3, Long Impingement Triplet	Valve-injector compatibility	5	0	
AF-27	POUL-31-2, Doublet	Injector-chamber compatibility	2	0	Injector failed during second firing and has been scrapped.
BF-13 (Baffled)	PONX-61-2, Quadlet	Pattern evaluation	1	0	Firing was rough. O/F-1.8 baffle suffered numerous weld cracks. Injector has been scrapped.
BF-5 (Baffled)	PONG-71-2, Pentad	Baffle durability	4	3	

[redacted]

Reaction Control Subsystem (RCS)

The RCS is being refined. The resulting improvements are being incorporated in the initial drawing release of the command module and service module RCS, which is nearing scheduled completion. Because the initial drawings are based on an equipment envelope specified in the procurement specifications, many S&ID detail drawing changes will be required as suppliers' drawings of components become available.

Command module RCS engine tests at Rocketdyne were limited to pulse performance evaluation of two Phase II engines. The engine configuration was the original prototype design and included a nozzle area ratio of 40:1, macerated ablative material with a conical joint, and a Gemini experimental throat. A report will be released when test results are evaluated.

Pressure drop tests have indicated that excessive pressure losses exist in the oxidizer flow path in the reaction control engine injector. Since it is not feasible to compensate for this by reducing the pressure drop across the oxidizer valve, two prototype engine injectors are being modified by increasing the diameter of the oxidizer discharge orifices. Modified engines will be tested to determine the effect of this change on the ablative material.

Installation drawings for the command module RCS engines in boilerplate 14 and spacecraft 001 have been released.

Test activity of the service module RCS engines at Marquardt is concentrated on efforts to reduce injector head soak-back temperatures. Preliminary results of tests conducted on an engine with a fuel-cooled injector and a stand-off oxidizer valve indicate that oxidizer temperatures are reduced considerably.

Limited effort has continued at Marquardt in the increase of the steady-state specific impulse performance of the engine to specification levels. Some improvement in performance has been obtained with a 12-on-12 injector, which also resulted in lower thrust chamber temperatures.

Operational difficulties with cell 6 at Marquardt have not been resolved. Engine performance measured in cell 6 is lower than that resulting from identical runs in Marquardt's Aerothermal Laboratory. Investigations are being conducted to determine the cause for this variation in test results.

Launch Escape Subsystem

Two pitch control motors were fired during this report period. Motors PC-16 and PC-21 were fired on 22 and 24 May, respectively. Both were temperature gradient motors of intermediate total impulse. PC-16 was fired after being conditioned to a temperature of 140 F, then exposed to a temperature of 20 F until the maximum attainable temperature gradient existed across the motor grain. PC-21 underwent tests with the opposite gradient. The ballistic effects of propellant temperature gradients were determined from the firing data.

Tower jettison motors AD-22 and AD-23 were fired at Thiokol on 23 and 27 May, respectively. Each motor was ignited at a temperature of 140 F after being temperature cycled and drop tested. Preliminary study indicates that all test objectives were achieved.

The launch escape motors and two pitch control motors for boilerplate 6 have been delivered to WSMR.

Twenty hot wire initiators were shipped to Thiokol on 2 June for use in pyrogen tests. The first 13 development firings of ignitor cartridges took place at Space Ordnance Systems on 27-28 May. The firing traces were smooth and repeatable. During the next report period, acceptance of the first lot of prototype initiators is to be complete, and the first delivery of prototype ignitor cartridges for pyrogen tests is expected.

The vibration testing of six tower jettison motors was successfully completed on 29 May.

INTEGRATION

System Integration

The Propulsion System Development Facility (PSDF) team effort is continuing to support the architect-engineer design activity with achievement of the following:

1. The construction contract for roads, water, and power to the test site at White Sands was let on schedule 7 May 1963.

2. The facility analysis document, Engineering Requirements for Apollo Propulsion System Development Test Facility, has been released and approved by NASA. The document reflects all criteria supplied the architect-engineer subcontractor to date.

A concept of the emergency detection system (EDS) for Saturn I has been established at NASA, S&ID, and MIT Crew Safety System Panel meetings. Requirements for the command module display and controls were determined and preliminary design of the Saturn I portion of the display and controls were presented and have been approved by NASA and S&ID. Spacecraft-to-launch vehicle interfaces have been defined and the Saturn I EDS controls and displays have been released for design implementation for boilerplates 14 and 18, and spacecraft 006, 008, 009, and 011.

Most documentation requests by Grumman have been for Apollo specifications to be used in conjunction with the lunar excursion module common usage study. Apollo reports, manuals, and FORTRAN programs on Apollo crew and mission analyses have been furnished to Grumman by S&ID.

Ground Support Equipment

Navigation and guidance equipment assembly sequence, and installation and repair ground rules were established at a meeting with MIT during the report period. Agreement was reached to use the same GSE for installation of the navigation base as is used to install the inertial measurement unit in the spacecraft.

GSE requirements for the support of boilerplates 16 and 26 at MSFC have been established and include the same GSE as that used for boilerplate 9. This consists of handling equipment (primarily to support operations associated with the command module), inserts, and an adapter. The GSE requirements for AMR will include the GSE models already required to support boilerplates 13 and 15.

The preliminary interface coordination documents for the prelaunch automatic checkout equipment (PACE) control room have been prepared and are being revised to reflect changes in system equipment and measurements. These documents are functional and will serve as a basis for detailed PACE-spacecraft design and operations. A 30-percent design review on the PACE response system was held with NASA during the report period. The detail logic design for the PACE command system is approximately 85 percent complete.

The redesign of the service module hoist beam has been completed. This redesign eliminates the necessity of removing the fairing between the service and command modules when attaching the hoist beam to the service module.

The earth landing system equipment weight and balance set has had a 100-percent NASA design review. A drawing change has been released that shows all items in outline form.

Action has been initiated to replace the spacecraft vertical transport vehicle with another vehicle that will be capable of transporting either the mated command and service modules or the mated command and service modules with the spacecraft adapter.

The special instrumentation test equipment is nearly completed. The switching matrix configuration has been sized, and spacecraft interface signals and sealer mechanizations have been defined.

All GSE engineering for boilerplate 6 has been released. GSE engineering on boilerplates 12 and 13 is scheduled for completion during the next report period.

Reliability

A preliminary study of the IFTS contribution to crew safety has been completed. The rationale for this study was that failures occurring in certain critical spacecraft electronics items would have to be isolated before corrective maintenance could be performed. In the event of failure in certain critical equipment such as the SCS control panel, power supply, or gimbal position indicator, observation of spacecraft performance or displays will provide sufficient information for corrective action. In the event of a failure in the SCS thrust vector control circuits, however, the number of individual subassemblies would appear to prohibit effective fault isolation without an IFTS. Without fault isolation and correction, alternate missions or crew recovery through abort would be improbable.

The reliability apportioned to the thrust vector control is 0.999697 without spares. With recommended on-board spares, this reliability approaches unity. The difference is therefore 303 failures per million missions and represents a like incremental change in crew losses, which is attributable to lack of fault isolation and correction.

Another consideration is the occurrence of multiple failures. The consequence of multiple failures on crew safety reliability can be shown in a case where a failure occurs, no fault isolation is available, and it is necessary to plug in all spare modules to the failed equipment. If a second failure occurs in the same equipment, another set of equipment is not available, and the probability of crew loss would be the same as the probability of the two failures occurring in the equipment. Calculations indicate an additional 4784 crew losses per million missions due to such multiple failures. The over-all effect on crew safety reliability is then the total crew losses due to the lack of fault isolation provisions and correction, or 5087 losses per million missions. It is recommended that the IFTS be a mandatory subsystem since the anticipated change in reliability, if no IFTS is provided, represents a 50 percent increase in crew losses.

Communications and data subsystem reliability apportionments were revised on the basis of lunar orbit rendezvous mission logic diagrams, the latest configurations, and current parts information. Sparing may be required in certain equipment to meet these new apportionments. A study on sparing is in progress.

Reliability predictions on the communications and data subsystem were submitted by the subcontractor. An analysis of these predictions is in progress to determine conformance to requirements and resultant action in areas of deficiency. Table 2 gives these apportioned and predicted values.

Table 2. Communications and Data Subsystem Apportionments and Predictions

Equipment	Reliability		Predicted Failure Rate per 1000 Hours
	Apportionment	Predicted	
Audio Center	0.9953	0.995961	0.99
C-band transponder	0.99938	0.998712	12.88
Controls and displays	0.980	0.996328	0.900
Data storage	0.9930	0.9925	8.58
HF transceiver	0.99972	0.99949	0.7802
Premodulation processor	0.9942	0.994957	1.5008
S-band power amplifier	0.9914	0.99324	5.7283
Signal conditioning	0.979	0.9746	7.5855
Unified S-band equipment	0.9930	0.9898	3.7957
VHF/AM transmitter-receiver	0.99904	0.999138	2.8748
VHF/FM transmitter	0.99987	0.999825	1.7548
VHF recovery beacon	0.99981	0.99835	2.2974

OPERATIONS

DOWNEY

The analog-to-digital format buffer system being built by the Electronic Engineering Company for the interim ground station is progressing on schedule. Preliminary acceptance testing will begin during the next report period.

Preliminary analysis of a stacked, integrated system checkout has indicated that the test objectives can be met by operations inside the hangar in an electrically mated mode. The layout for interim area test preparation activities has been submitted and approved. The layout is based on the Air Force hangar area at AMR.

WHITE SANDS MISSILE RANGE

Delivery of test fixture F-2 from NAA—Los Angeles is expected during the latter part of July 1963. It has been proposed that all fixture F-2 test preparations be performed at NAA-Los Angeles. This will eliminate the need for a special test preparation area at S&ID.

The 50-percent review of WSMR complex No. 1 was completed on 24 May 1963. Major issues determined during this review were the configuration of fire controls, requirements for an emergency power unit, and test stand grounding requirements. The U. S. Army Corps of Engineers states that a joint occupancy date of 15 September 1963 is planned.

All structural steel work on the mission abort test vehicle assembly building is complete. Concrete floors have been poured in both of the west bays; concrete block walls for the southeast corner are approximately 80 percent complete.

During the next report period, the tests on boilerplate 6 will be completed at Downey, and the boilerplate will be shipped to WSMR.

Planning functions will be completed, and boilerplate 12 will be prepared for delivery to the Downey test preparation area.

The facility design reviews will be completed through the 95-percent design stage of complex No. 2 at WSMR.

ATLANTIC MISSILE RANGE

A special study indicates that leakage tests of the command module for boilerplate 13 will be required in the test preparation area at Downey and in the Air Force Hangar at AMR to ensure proper air cooling of instrumentation.

LOGISTICS SUPPORT

Training

The requirements and supporting data for Apollo systems trainers were forwarded to NASA.

Logistics Engineering

The revisions to the Apollo Maintenance Concept and the Apollo Maintenance Plan were submitted to NASA during this reporting period.

Site Support

A direct TWX communications system has been established between S&ID and WSMR.

FACILITIES

INDUSTRIAL ENGINEERING

A budgetary and planning estimate for facilities contract funds for fiscal 1964 was prepared and submitted to NASA during the report period.

The interim boilerplate test and operations area is in operation and all office and supporting areas are located.

The rehabilitation of the Apollo segment of the El Centro Naval Air Facility is complete.

FACILITIES PROJECTS

Systems Integration and Checkout Facility

Structural steel erection is 25 percent complete; underground electrical power distribution ductwork is 80 percent complete.

Building 6 Modification

The construction contract has been awarded for the modification of Building 6 at Downey.

Space Systems Development Facility

Construction of the main building will begin during the next report period.

The hazards evaluation committee has approved the air lock for man-rating the vacuum chamber.

APPENDIX A

S&ID SCHEDULE OF APOLLO MEETINGS AND TRIPS

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963

Subject	Location	Date	S&ID Representatives	Organization
Documentation requirements coordination	Minneapolis, Minnesota	16 May	Frankos, Calvert	S&ID, Minneapolis-Honeywell
Sequencers meeting	Houston, Texas	16 May	Nichols, Miller, Solomon, Proctor	S&ID, NASA
Design and telemetry system meeting	Metuchen, New Jersey	16-17 May	Schwarzmann, Manaker, Musso	S&ID, Applied Electronics
Design review meeting	Joplin, Missouri	17 May	Milliken, Meurisse	S&ID, Eagle-Picher
Contract negotiations	Houston, Texas	17 May	Scope, Lashbrook	S&ID, NASA
Negotiations meeting	Hartford, Connecticut	17-24 May	Barker, Snyder, Nash	S&ID, Pratt & Whitney
Committee meeting	Houston, Texas	19 May	DeWitt	S&ID, NASA
Communications system coordination	Cedar Rapids, Iowa	19-22 May	Bakken	S&ID, Collins
Training conference	Houston, Texas	19-23 May	Steisslinger, Pfanner, Fox, McNeese	S&ID, NASA
Interface specification and cost arrangement meeting	Melville, Long Island, New York	19-23 May	Shafer, McCabe, Anderson, Shaw, McTeague, Brooks	S&ID, Airborne Instruments
Contracts review	Falls Church, Virginia; Silver Springs, Maryland	19-24 May	Anderson	S&ID, Melpar S&ID, Emertron
Life systems coordination	Columbus, Ohio	19-31 May	Shamis, Johnson	S&ID, NAA-Columbus
Schedule discussion	Houston, Texas	20 May	Sherman, Benner	S&ID, NASA
Fuel cell negotiations	Hartford, Connecticut	20 May	Wermuth, Barker, Nash, Meyer	S&ID, Pratt & Whitney
Weights and balance meeting	Houston, Texas; AMR; Clearwater, Florida	20 May	Hedger	S&ID, NASA S&ID, McDonnell

S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Program status review and facility survey	Wilmington, Massachusetts	20 May	Lowery, Weller, Morant	S&ID, Avco
Stimuli and measurement list coordination	Minneapolis, Minnesota	20 May	Jarvis	S&ID, Minneapolis-Honeywell
Instrumentation meeting	Houston, Texas	20 May	Page, Chiavacci, Nowicki	S&ID, NASA
PCM coordination	Melbourne, Florida	20 May	Dorrell	S&ID, Radiation Inc.
Policy meeting	Downey, California	20-22 May	Fleetwood	S&ID, NASA
Support coordination	WSMR	20-22 May	Lane, Bevan	S&ID, NASA
Transducer evaluation	Seattle, Washington	20-22 May	Ullery	S&ID, Boeing
Field analysis	Newberry Park, California	20-24 May	Beatty	S&ID, Northrop-Ventura
Docking simulation meeting	Columbus, Ohio	20-24 May	Krimgold	S&ID, NAA-Columbus
Contract change negotiation	Lima, Ohio	20-24 May	Abrahamson	S&ID, Westinghouse
Formats and procedures	WSMR, AMR	20-24 May	Paden Emrich	S&ID, NASA
Program coordination	WSMR	21 May	Thornton	S&ID, NASA
Vendor data coordination	Culver City, California	21 May	Comensky, Gaskey	S&ID, Arnoux
EPS/ECS meeting	Houston, Texas	21 May	Stelzriede, Bouman, Reithmaier, Barnett, Adlestone	S&ID, NASA
Design engineering inspection	Downey, California	21 May	Vanderwall	S&ID, NASA
Structural-mechanical systems meeting	Houston, Texas	21-22 May	Johnson, Underwood, Peterson, Helms	S&ID, NASA
Logistics data coordination	Van Nuys, California	21-22 May	Cooper, Lanxner	S&ID, Marquardt
Flight measurement lists discussion	Houston, Texas	21-22 May	Langmore, Eckmeier	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Operations presentation and problems coordination	AMR	21-23 May	Gore, Lindsay	S&ID, NASA
Subsystem panel meeting	Houston, Texas	21-23 May	Dorrell	S&ID, NASA
Stabilization control system coordination	Minneapolis, Minnesota	21-23 May	Bakken	S&ID, Minneapolis-Honeywell
Organization meeting	Columbus, Ohio	21-23 May	Lale	S&ID, NAA-Columbus
Guidance and navigation discussion	Cambridge, Massachusetts	21-23 May	Zeitlin, Breary, Hillberg, Kasten, Rose, Cauble, Johnson, Archer, Todd	S&ID, MIT
Boilerplate coordination	WSMR	21-24 May	Ginely	S&ID, NASA
Technical liaison	AMR	21-24 May	Indelicato	S&ID, NASA
Letter contract review	Princeton, New Jersey	21-24 May	Stady	S&ID, RCA
Manufacturing review	Boulder, Colorado	21-24 May	Calvert	S&ID, Beech Aircraft
GSE engineering support	WSMR	21 May 18 June	Lobosco	S&ID, NASA
Instrumentation coordination	Downey, California	22 May	Jorgenson	S&ID, NASA
Flight technology meeting	Huntsville, Alabama	22 May	Pion, Cooper, Flatto, Schall	S&ID, NASA
Weight coordination	Boulder, Colorado	22 May	McBaine	S&ID, Beech Aircraft
Instrumentation meeting	St. Paul, Minnesota	22 May	Oleson	S&ID, Minneapolis-Honeywell
Model tests support	Tullahoma, Tennessee	22 May	McNary	S&ID, NASA
Circuit design and weight review	Phoenix, Arizona	22 May	Hall	S&ID, Motorola
Wind tunnel tests	Mountain View, California	22 May	Allen, Schurr, Scottoline	S&ID, Ames
Space suit interface meeting	Bethpage, Long Island, New York	22 May	Dziedziula	S&ID, Grumman

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Propellant behavior discussion	Menlo Park, California	22 May	Gille	S&ID, Stanford Research Institute
Trainer meeting	Houston, Texas	22 May	Marshall, Secrist, Dudek, Smith, Clark, Matthews	S&ID, NASA
Stabilization and control meeting	Houston, Texas	22 May	Antletz, Foute, Stiles, Miller, Madden	S&ID, NASA
Quarterly briefing and design review meeting	Wilmington, Massachusetts	22 May	Hanifin, Skene, Kinsler, Gershun	S&ID, Avco
Program status review	Wilmington, Massachusetts	22-24 May	Piroutek	S&ID, Avco
Purchasing evaluation	Wilmington, Massachusetts	22-24 May	Stafford	S&ID, Avco
Transfer coordination	Middletown, Ohio	22-24 May	Stover	S&ID, Aeronca
Field test analysis	Binghamton, New York	23-25 May	Cooper	S&ID, GP-Link Division
Training operations familiarization	AMR	23-24 May	Robertson, LaFrance	S&ID, NASA
Spares meeting	Downey, California	23-24 May	Akers	S&ID, NASA
Requirements meeting	Melbourne, Florida	23-24 May	Bakken	S&ID, NASA, Radiation Inc.
Equipment layout determination	AMR	23-24 May	Celia, Keir	S&ID, NASA
Boilerplate discussion	Houston, Texas	23-24 May	Stevens, Brown, Yorgiadis, Dupaquier	S&ID, NASA
Vendor survey	Indianapolis, Indiana	23-24 May	Errington	S&ID, GM-Allison
Program review	Sacramento, California	24 May	Field, Ross	S&ID, Minneapolis-Honeywell
Status and reliability meeting	Minneapolis, Minnesota	24 May	Kalayjian	S&ID, Minneapolis-Honeywell
Mechanical integration panel meeting	Huntsville, Alabama	24 May	Tooley, Gaffney	S&ID, NASA
Coordination meeting	Melbourne, Florida	24 May	Whitehead, Dorrell	S&ID, Radiation Inc.

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Facility inspection	Plattsburgh, New York	24-28 May	Reichard	S&ID, USAF
PERT network construction	Cedar Rapids, Iowa	24-31 May	Studen, VanHorn	S&ID, Collins
PERT coordination	Minneapolis, Minnesota	26 May	Anderson	S&ID, Minneapolis-Honeywell
Human tolerance discussion	Houston, Texas	26 May	Oliver	S&ID, NASA
Field analysis	Buffalo, New York	26 May	Myers, Hobson, White, Gibb, Vevington, Burge	S&ID, Bell Aerosystems
Quarterly management briefing	Elkton, Maryland	26 May	Bergeron, Yee, Greco	S&ID, Thiokol
Life systems coordination	Columbus, Ohio	26 May	Kulp	S&ID, NAA-Columbus
Crew systems meeting	Houston, Texas	26-30 May	DeWitt, Tarr, Brewer	S&ID, NASA
Contract negotiation	Dayton, Ohio	27 May	Wagner, Raggett, Olsen	S&ID, United Aircraft
Test techniques discussion	Tullahoma, Tennessee	27 May	McNary	S&ID, AEDC
Logistics data coordination	Los Angeles, California	27 May	Mitchell, Comensky	S&ID, Hughes Electronic
EMI meeting	Downey, California	27 May	Bowden	S&ID, NASA
Producibility problems discussion	Tulsa, Oklahoma	27-28 May	Olsen, Skene	S&ID, NAA-Tulsa
Simulation studies discussion	Columbus, Ohio	27-29 May	Barnett	S&ID, NAA-Columbus
Parachute drop tests	Downey, California	27-29 May	Butler	S&ID, NASA
Detailed schedules discussion	Cedar Rapids, Iowa	27-29 May	Rousculp	S&ID, Collins
Docking simulation study	Columbus, Ohio	28 May	Scheiman	S&ID, NASA
Entry flight systems discussion	Minneapolis, Minnesota	28 May	Fouts, Jansz	S&ID, Minneapolis-Honeywell

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S&ID Schedule of Apollo Meetings and Trips 16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Navigation and guidance meeting	Houston, Texas	28 May	Louie, Hedvig, Norton	S&ID, NASA
Hardware requirements	Cambridge, Massachusetts	28 May	McCarthy, Martin, Siev	S&ID, MIT
Food contract coordination	Menlo Park, California	28 May	Hiar, Osborne	S&ID, Stanford Research Institute
Engineering evaluation	Long Island City, New York	28 May	Wishon, Kooiman	S&ID, Alderson Research
Boilerplate modification	El Centro, California	28-29 May	Young, Widener, Gibbs, Dowling	S&ID, 6511th Test Group
Pressure tests	Buffalo, New York	29 May	Snowden	S&ID, Cornell Aeronautical Laboratory
Progress review	Indianapolis, Indiana	29 May	Skene, Nicholas	S&ID, GM-Allison
Static tests	El Centro, California	29 May	Leonard, Rodier, Trebes	S&ID, 6511th Test Group
GSE liaison	Minneapolis, Minnesota	29 May	Svegel	S&ID, Minneapolis-Honeywell
Space station meeting	Downey, California	29 May	Laidlow	S&ID, NASA
Instrumentation and flight meeting	Houston, Texas	29 May	Wolff, Tomita, Barmore	S&ID, NASA
Flight technology	Houston, Texas	29 May	Dodds, Gershun, Harthun, Lundgren	S&ID, NASA
Wind tunnel tests	Hampton, Virginia	31 May	Snowden	S&ID, Langley Research Lab.
Docking simulation study	Columbus, Ohio	31 May	Spindell	S&ID, NAA-Columbus
Test data and methods discussion	Dayton, Ohio	31 May	Schreihans	S&ID, USAF
Technical meeting	Minneapolis, Minnesota	1 June	Hindi	S&ID, Minneapolis-Honeywell
Procurement specification review	Terrytown, New York	1 June	Lewin, Wagner, Gleason, Haggstrom, Gardiner	S&ID, Simmonds Precision Products
Contract negotiations	Hartford, Connecticut	2 June	Wermuth, Barker, Nash, Tayne	S&ID, Pratt & Whitney

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Design progress review	Tulsa, Oklahoma	2 June	Cox	S&ID, NAA-Tulsa
Boilerplate coordination	WSMR	2-7 June	Ginley	S&ID, NASA
Digital programming discussion	Houston, Texas	3 June	Segeyevaky	S&ID, NASA
Propulsion engine test	Tullahoma, Tennessee	3 June	Gallanes, McNary	S&ID, AEDC
Work transfer request	Tulsa, Oklahoma	3 June	Patterson	S&ID, NAA-Tulsa
Engineering representative	Houston, Texas	3 June	Wroble	S&ID, NASA
Propulsion systems meeting	Houston, Texas	3 June	Bellamy, Beatty, Babcock, Simkin	S&ID, NASA
Systems interface meeting	Houston, Texas	3 June	Rogers, Bowers, Day	S&ID, NASA
Docking simulation study	Columbus, Ohio	3-5 June	Peterson	S&ID, NAA-Columbus
Checkout panel meeting	AMR	3-5 June	Kiehlo, McMullin, Gebhart	S&ID, NASA
Engineering coordination	Boulder, Colorado	3-6 June	Bouman, Haglund	S&ID, Beech
GSE familiarization	AMR	3-6 June	Shelley, Cooper	S&ID, NASA
Contract negotiations	Newberry Park, California	3-7 June	Beatty	S&ID, Northrop-Ventura
Facilities and techniques meeting	Wilmington, Massachusetts	3-9 June	Beckerle, Biwersi	S&ID, Avco
Construction surveillance support plans	WSMR	3-14 June	Young	S&ID, NASA
Contract change	Lima, Ohio	3-19 June	Quebedeaux, Cannon, Abrahamson, Dempsey, Goharing	S&ID, Westinghouse
Parachute drop tests	El Centro, California	3 June 4 July	Young, Duffy	S&ID, 6511th Test Group
GSE design status	Tulsa, Oklahoma	4 June	Robertson, Knoll	S&ID, NAA-Tulsa
Trajectory meeting	Houston, Texas	4 June	Meyers, Kakuske, Meston, Johnson	S&ID, NASA

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Simulation program meeting	Grand Prairie, Texas	4 June	Vucelic, Tutt, Armstrong	S&ID, Ling Temco Vought
Pretest conference and plasma tests	Chicago, Illinois	4 June	Monda	S&ID, University of Chicago - Chicago Midway Laboratories
Checkout panel meeting	AMR	4-5 June	Shelley, Cooper, Lindley, Kiehlo, Schwarzmann, McMullin, Bradanini, Siwolop, Gebhart	S&ID, NASA
Material tests	Cedar Rapids, Iowa	4-6 June	Blankenship	S&ID, Collins
Internal procedures review	Middletown, Ohio	4-7 June	Stover	S&ID, Aeronca
Weights coordination	Cedar Rapids, Iowa	5 June	Sturkie, Frost	S&ID, Collins
Shipping container tests	Hartford, Connecticut	5 June	Eng	S&ID, Pratt & Whitney
Technical coordination	Bethpage, Long Island, New York	5 June	Bologna, Kronsberg	S&ID, Grumman
Mechanical integration meeting	Houston, Texas	5 June	Tooley, Gaffney, Lindsay	S&ID, NASA
ICD's coordination	Houston, Texas	5 June	Garner, Crawford	S&ID, Northrop-Ventura
Parachute installation procedures	El Centro, California	5-11 June	Vipond	S&ID, Northrop-Ventura
Food program discussion	Menlo Park, California	6 June	Hair, Tarr	S&ID, Stanford Research Institute
Test stand coordination	Sacramento, California	6 June	Thurman, Borde	S&ID, Aerojet-General
Computer change meeting	Downey, California	6 June	Todd	S&ID, MIT
Docking simulation study	Columbus, Ohio	6-13 June	Canby	S&ID, NAA-Columbus
Test set meeting	Minneapolis, Minnesota	6-16 June	Gibson	S&ID, Minneapolis-Honeywell
Support manuals meeting	Downey, California	7 June	Comensky	S&ID, Collins

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S&ID Schedule of Apollo Meetings and Trips 16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Wind tunnel tests	Hampton, Virginia	7 June	Ufer	S&ID, Langley Research
Mission simulator meeting	Binghamton, New York	7 June	Shoytush	S&ID, GP-Link Division
Boilerplate preparation	El Centro, California	7 June	Brayton, Rodier, Trebes	S&ID, 6511th Test Group
Stabilization and control	Houston, Texas	7-10 June	Eckmeier, Jarvis	S&ID, NASA
Service manual requirements meeting	Binghamton, New York	7-11 June	Lanxner	S&ID, GP-Link Division
Manufacturing progress review	Indianapolis, Indiana	9 June	Perry	S&ID, GM-Allison
Procedures meeting	Hartford, Connecticut	10-12 June	Cooke, Scott	S&ID, Pratt & Whitney
Problems coordination	WSMR	10-11 June	Stungis, Witt	S&ID, NASA
Apollo reliability meeting	Cambridge, Massachusetts	10-11 June	Fatton, Carpenter, Murad	S&ID, MIT
Logistics service manual status	Houston, Texas	10-11 June	Morton, Coulson, Maleck, Sandham	S&ID, NASA
Crew safety meeting	Houston, Texas	10-11 June	Vucelic, Wheelock, Tutt	S&ID, NASA
GSE meeting	Houston, Texas	10-13 June	Coulson, Maleck, Drucker, Bagnell, Moore, Bonsack, Hemond, Buzisiz, Phillips, Embody, Hedger	S&ID, NASA
Coordination meeting	Houston, Texas	10-13 June	Ogren, Nelson, Nichols, Divvens, Bouman	S&ID, NASA
Design review	Houston, Texas	11 June	Dysart, Page, Smith, Galen	S&ID, NASA
Interface information	Melbourne, Florida	11 June	Hemond, Symm	S&ID, Radiation, Inc.
GSE design and critical schedule review	Tulsa, Oklahoma	11 June	Nichols	S&ID, NAA-Tulsa
Wind tunnel tests	Buffalo, New York	11 June	Biss, Scottoline, Emerson	S&ID, Cornell Aeronautical Laboratory
Docking design tests	St. Louis, Missouri	11 June	Gustavson, Underwood, Neatherlin, Peterson	S&ID, McDonnell

S&ID Schedule of Apollo Meetings and Trips 16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
GSE site plan	AMR	11-15 June	Yim, Grycel	S&ID, NASA
Schedule meeting	Houston, Texas; Minneapolis, Minnesota	11-15 June	Dyson	S&ID, NASA S&ID, Minneapolis-Honeywell
Status reporting and program control coordination	WSMR	12 June	Ponce	S&ID, NASA
Radar study discussion	Menlo Park, California	12 June	Smith	S&ID, Stanford University
System performance study	Houston, Texas	12 June	Stoll	S&ID, NASA
Technical interchange	Wilmington, Massachusetts	12 June	Hanifin, Johnson, Walkover, Gershun, Morant, Nixon, Nelson, Augustus	S&ID, Avco
Coordination meeting	Boulder, Colorado	12 June	White, Van Pelt, Peery, Westfall, Carter	S&ID, Beech
Facility survey	Cleveland, Ohio	12 June	Shat, Speight, Butler	S&ID, Lear-Siegler
Test equipment installation	Mountain View, California	12 June	Takvorian	S&ID, Ames
Monthly coordination	Boulder, Colorado	12 June	Bouman, Krainess, Davis, Haglund	S&ID, NASA
Monthly coordination	Binghamton, New York	12 June	Hatchell, Banta	S&ID, GP-Link Division
Radioisotopes and feasibility studies meeting	White Plains, New York; Washington, D.C.	12-14 June	Raymes	S&ID, United Nuclear S&ID, NASA
Design operations review	Bethpage, Long Island, New York	12-14 June	Benner, Gustavson, Hannon, Opdyke, Pearce, Pyle, Sherman, Underwood, Schwarzmann	S&ID, Grumman
Logistics data coordination	Cincinnati, Ohio	12-14 June	Van Gundy	S&ID, Keco
Warehouse and boilerplate coordination	WSMR	12-15 June	Ginley, Fish	S&ID, NASA
Delivery schedule meeting	Richardson, Texas	12-15 June	Weiss	S&ID, Texas Richardson

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S&ID Schedule of Apollo Meetings and Trips
16 May to 15 June 1963 (Cont)

Subject	Location	Date	S&ID Representatives	Organization
Electrical wiring checkout	WSMR	12-21 June	Thornton, Griffith-Jones	S&ID, NASA
Mock-up review	Binghamton, Long Island, New York	12-21 June	Hatchell, Selby	S&ID, GP-Link Division
Documentation coordination	Culver City, California	13 June	Johnson	S&ID, Arnoux Corporation
Equipment conference	Newberry Park, California	13 June	Matson, Idleman, Cagni, Miltko, Wilson, Vaughn, Otterstein	S&ID, Northrop-Ventura
Design and development meeting	Cedar Rapids, Iowa	13 June	Moore, Himmelberg, Shear	S&ID, Collins
Full pressure suit indoctrination	San Diego, California	13 June	Turner, Andrews, Komorowski, Meiche, Andrews	S&ID, North Island Training School
Crew systems meeting	Downey, California	13 June	Lane, Tarr	S&ID, NASA
Field analysis	Wilmington, Massachusetts	13 June	Lowery, Felis	S&ID, Avco
Tooling coordination	Indianapolis, Indiana	15-24 June	Westfall, Van Pelt	S&ID, GM-Allison

APPENDIX B

DOCUMENTATION LIST

DOCUMENTATION LIST*

SID 62-300-13	Apollo Monthly Progress Report for Period 16 April to 15 May 1963
SID 63-627	Apollo Combined Systems Maintenance Procedures, SM2A-01-2-BP 6
SID 62-384-32	Drawing List, Apollo Spacecraft, Complete
SID 62-417	Ground Support Equipment Planning & Requirements
SID 63-623	Experimental Heat Transfer and Pressure Distributions Over Energy Configurations of 0. 02-Scale Apollo Models H-1 and PS-1, and Hemisphere Cylinders H-9 and PS-9 at Mach No. 10
SID 63-54	Calibration Report for the 0. 08-Scale Apollo Structural Dynamics Model/SD-1/in the Landley 16-Foot Transonic Dynamics Wind Tunnel
SID 63-608	Pretest Report for Low-Speed Tests on the 0. 105-Scale Apollo FS-2 Command Module Static Force Model at High Roll Angles in the 7- by 7-Foot NAA Transonic Wind Tunnel
SID 63-180	Apollo Documentation List
SID 62-557-5	Quarterly Reliability Status Report for Period 1 January to 31 March 1963
SID 62-99-16	Monthly Weight and Balance Report for the Apollo Spacecraft
SID 62-367-77	Motion Picture Photography, Lockheed Tower Tie-down Test of the Launch Escape System
SID 62-367-82	Motion Picture Photography; Pratt & Whitney Inspection and Assembly of Fuel Cells Prior to Filling With Electrolyte, Preparation of a Power Plant for the First Vacuum-Temperature Environmental Tests

*Documentation published during the report period

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SID 62-367-84	Motion Picture Photographs, Marquart Analysis and Testing of Materials Before and After use in the Apollo SM RCS Rocket Engine
SID 62-822-3	Apollo Monthly Failure Summary for Period May 1963